Oct. 25, 1966 D. J. MAYHEW ET AL 3,281,156

PISTON RING ASSEMBLY

Filed Dec. 12, 1963 2 Sheets-Sheet 1

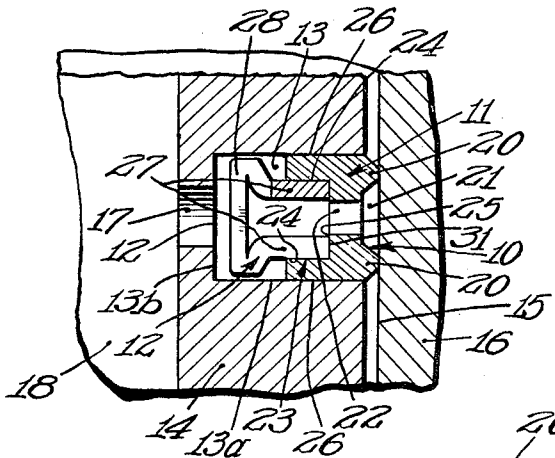


Fig. 1

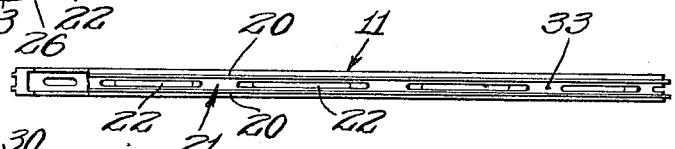


Fig. 3

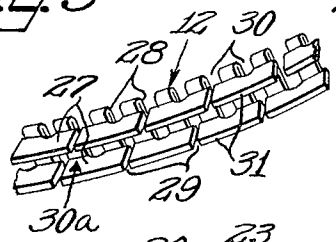


Fig. 4

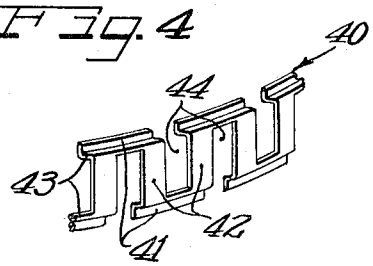


Fig. 6

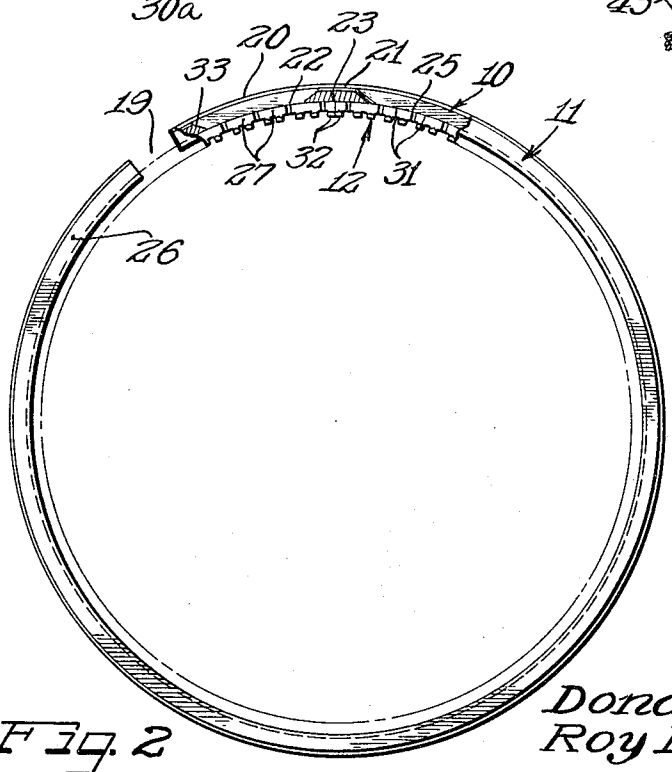


Fig. 2

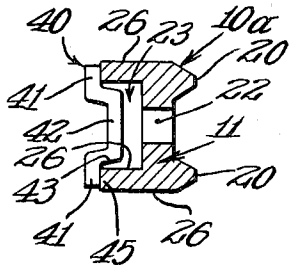


Fig. 5

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Fig. 7

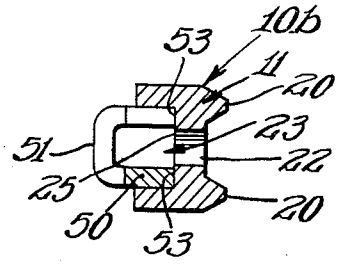


Fig. 8

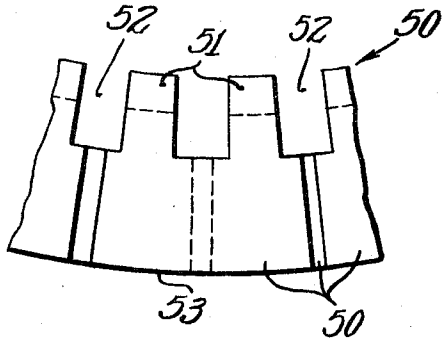


Fig. 9

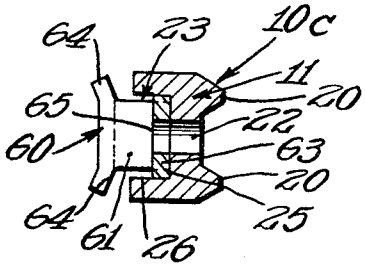


Fig. 10

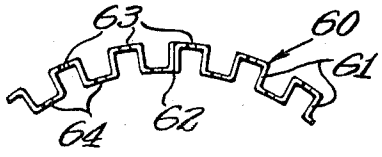


Fig. 11

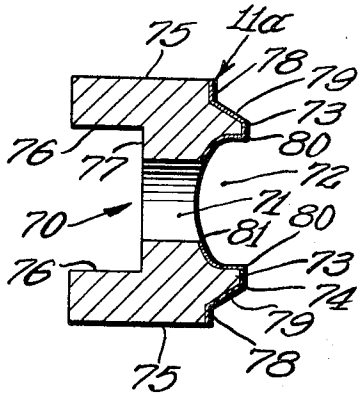
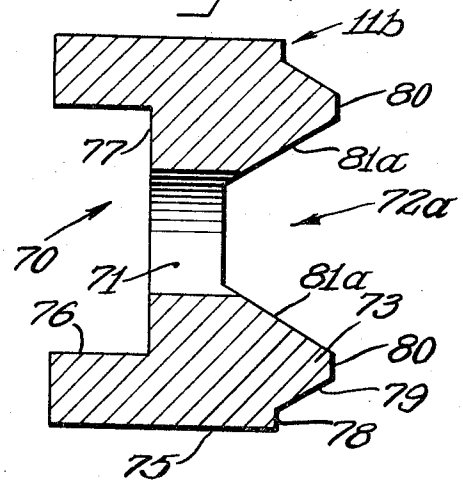


Fig. 12



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PISTON RING ASSEMBLY

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Filed Dec. 12, 1963, Ser. No. 330,134
3 Claims. (Cl. 277—140)

This invention relates to a piston ring and expander assembly having excellent conformability with the bore or cylinder wall of an engine and more specifically deals with a two component oil ring assembly suited for heavy duty engine applications and possessing a high degree of flexibility.

The present invention will hereinafter be specifically described as embodied in an oil control ring for the pistons of internal combustion engines, but it will be understood that the principles of this invention are generally applicable to packing rings and therefore the scope of the invention is not limited to the specifically described embodiments.

Oil ring assemblies for pistons of internal combustion engines have heretofore been composed of a single ring backed by an expander which is bottomed in the piston ring groove or of a pair of thin rail rings supported on a spacer-expander which did not have to be bottomed in the groove of the piston. The expander backed single ring assembly is quite rigid and only engages the grooves bottomed expander at several widely spaced circumferential points thereby preventing uniform loading and good bore conformability. The pair of rail rings, and spacer-expander assemblies, being composed of at least three components, is difficult to install, and often has the rails thereof acting independently to flip back and forth creating a paint brushing action which is detrimental to good oil control.

Therefore, the scraping edge of the rail ring must be rounded to prevent bore damage as the rails flip back and forth and efficient sharp scraping edges are not available in these rail ring assemblies. Further, the rail rings must have an appreciable radial width to be retained in the ring groove and to permit manufacture by coiling. They cannot have the radial flexibility of shallow rings and thus these assemblies do not have a high degree of conformability.

The present invention now avoids the deficiencies of heretofore available two piece and three piece oil ring assemblies by providing a channel shaped oil ring receiving in the channel thereof an expander ring which exerts its expanding force around the entire circumference of the oil ring in substantially continuous circumferential contact therewith. The channel oil rings of this invention are quite shallow in radial depth and the expander rings are of the circumferentially expansion or garter spring type which need not bottom in the ring groove of the piston. The entire assembly is thus very flexible and quickly conforms to the bore of the cylinder for exerting uniform radial pressure on the cylinder wall.

The channel oil ring has a plurality of axially spaced peripheral scraping edges which can be designed to efficiently scrape the cylinder wall because the ring cannot flip back and forth and the several sets of scraping edges are fixed relative to each other. This channel oil ring also has a very open drainage path between the scraping edges and the expander ring in the channel has a high capacity darinage area around the entire circumference thereof to produce a non-clogging high drainage capacity oil flow channel from the scraping edges to the drainage holes in the piston ring groove. Since the one piece oil ring receives the one piece expander ring in the channel thereof the assembly is easily installed as a unit and automatic installing equipment can be used which was heretofore not available for use with the three piece rail ring assemblies or the prior known groove bottomed expander backed oil rings.

It is then an object of this invention to provide a highly flexible expander-piston ring assembly which maintains uniform radial pressure on a cylinder wall.

Another object of this invention is to provide a two piece expander-oil ring assembly which is very flexible in a radial direction.

Another object of this invention is to provide a channel-shaped oil ring with a plurality of scraping edges directing oil into the channel and with an open garter spring type expander seated in the channel to exert a substantially continuous circumferential expansion around the entire ring.

Another object of this invention is to provide a two piece oil ring assembly with an expander that does not have to be bottomed on the oil ring groove of the piston.

A still further object of this invention is to provide an oil ring with a plurality of axially spaced scraping edges in fixed relation to each other and having an open channel between the edges to receive oil therefrom and to provide a seat for a garter spring type expander.

Another object of this invention is to provide a two component oil ring unit which can be installed in a piston ring groove with automatic machinery.

Another object of this invention is to provide an oil ring for pistons including a one piece outer ring with a pluralty of circumferential scraping edges and an inwardly opening channel between the scraping edges receiving a channel type expander ring with the side legs of the expander ring exerting a substantially continuous expanding force around the entire periphery of the oil ring.

Other and further objects of this invention will be apparent to those skilled in this art from the following detailed description of the annexed sheets of drawings which show several embodiments of the invention.

On the drawings:

FIGURE 1 is a fragmentary vertical cross sectional view of a piston and cylinder assembly equipped with an oil ring assembly of this invention.

FIGURE 2 is a plan view of the oil ring assembly of FIGURE 1 with parts broken away to show underlying parts.

FIGURE 3 is a fragmentary isometric view of the expander ring of the assembly of FIGURES 1 and 2.

FIGURE 4 is a side elevational view of the oil ring of the assembly of FIGURES 1 and 2 with a part broken away to show an underlying portion.

FIGURE 5 is a transverse cross sectional view of another oil ring assembly according to this invention.

FIGURE 6 is a view similar to FIGURE 3 but illustrating the expander for the assembly of FIGURE 5.

FIGURE 7 is a transverse cross sectional view of a further modified form of oil ring assembly according to this invention.

FIGURE 8 is a fragmentary plan view of the expander in the assembly of FIGURE 7.

FIGURE 9 is a transverse cross sectional view similar to FIGURES 5 and 7 but illustrating another form of assembly of this invention.

FIGURE 10 is a fragmentary plan view of the expander in the assembly of FIGURE 9.

FIGURE 11 is an enlarged vertical cross section of a modified oil ring of this invention.

FIGURE 12 is a greatly enlarged cross section of a still further modified oil ring of this invention.

As shown on the drawings:

In FIGS. 1 and 2 the reference numeral **10** designates a piston ring assembly of this invention including a one

piece oil ring **11** and a one piece garter spring type expander ring **12**. The assembly **10** is illustrated in FIG. 1 as mounted in the oil ring groove **13** of an internal combustion engine piston **14** operating in the bore **15** of an engine cylinder **16**. It will of course be appreciated that the pistion **14** is equipped with the conventional top ring grooves above the oil ring groove **13**. The oil ring groove **13** drains through conventional drainage or smoke holes **17** to the interior **18** of the piston.

The oil ring **11** may be a cast iron or a steel ring and may be plain or coated with hard facing metals such as molybdenum or chromium. The ring **11** is split and as shown in FIG. 2, in its free state, a gap **19** is provided between the split ends thereof which gap of course is decreased to a very narrow slit when the ring is compressed into the bore **15**.

The ring **11** has a pair of axially spaced protruding beads or rims **20** therearound each providing a sharp scraping edge engaging the bore wall **15**. An open continuous groove **21** is provided around the ring between these beads **20** and the bottom of this groove is provided with a plurality of closely spaced circumferentially elongated openings or slots **22** joining the groove with a substantially rectangular channel **23** around the inner periphery of the ring. The channel **23** has flat radial side walls **24** and an axial back wall **25** at right angle relation thereto.

The ring **11** has flat top and bottom faces **26** slidably and sealingly engaging the side wall **13***a* of the piston ring groove **13** and the radial dimension of the ring is quite shallow so that it only fills the outer portion of the ring groove. The beads or rims **20** project beyond the ring groove to span the gap between the piston and the bore for scraping against the bore wall.

The expander **12** is of the garter spring circumferentially expanding type which does not bottom on the bottom **13***b* of the ring groove for obtaining its expanding force. The expander ring **12** as shown in FIG. 3 is composed of spring steel with top and bottom rows of circumferentially spaced arcuate segments or legs **27** connected by circumferentially spaced upstanding fingers **28**. As shown these fingers are disposed around the inner periphery of the ring **12** and the top and bottom rows of segments are in staggered relation so that the segment of one row is connected to an adjacent segment in the other row by a finger. The segments **27** have gaps or slots **29** therebetween, the fingers **28** have open spaces **30** therebetween and the top and bottom rows of segments **27** provide a wide open channel **30***a* therebetween. When the ring **12** is circumferentially compressed to decrease the free state widths of the slots **29** the ring exerts a uniform radial expansion force around the entire periphery thereof.

Each segment **27** has an outer peripheral edge **31** to transmit this radial expansion force.

As shown in FIG. 1 the segments **27** are seated in the channel **23** of the ring **11** on the side wall **24** thereof and their peripheral edges **31** are bottomed on the end wall **25** of this channel. The legs **28** fit freely in the ring groove **13** in spaced relation inwardly from the side walls **13***a* thereof and outwardly from the bottom wall **13***b* thereof.

As shown in FIG. 2 the ring **12** is split and when assembled the ends **32** thereof are abutted together in the channel **23** of the ring **11**. As also shown in FIG. 2 the radial force transmitting peripheral edges **31** of the ring **12** form a substantially continuous contact with the back or bottom wall **25** of the channel of the ring **11** around the entire periphery of this ring.

Since in effect, the only solid areas of the ring **11** between the beads or rims **20** thereof are those legs or lands **33** between the slots **22**, the ring **11** has a very open oil drainage path between the scraping edges into the

channel **23**. The expander **12** also has a wide open flow path therethrough provided by the open channel between the segments and the spaces between the fingers. As a result oil scraped from the bore wall **15** can flow freely between the scraping edges of the ring to the drain holes **17** of the ring groove.

Since the segments **27** of the ring **12** fit in the channel **23** of the ring **11** a unitary easily installed assembly is provided which does not require bottoming or centering in the piston groove **13** because the parts are preassembled for operation. The scraping edges provided by the rim **20** are fixed relative to each other and sliding contact of the flat faces **26** of the ring on the flat side walls **13***a* of the ring groove prevent cocking or rocking of the edges. The ring **11** can be made very shallow in a radial dimension so as to have extremely high flexibility and conformability with the bore wall **15** and the substantially continuous circumferential contact between the radial expansion force transmitting edges **31** of the ring segments **27** with the bottom wall **25** of the channel **23** insure uniform loading of the ring **11**.

In a modified assembly **10***a* of FIG. 5 the same oil ring **11** described above is provided but the channel **23** thereof receives a modified expansion ring **40** shown in FIG. 6. The ring **40** includes top and bottom rows of circumferentially spaced upstanding segments **41** connected by spring fingers or legs **42** that are forwardly offset from the segments **41** by means of shoulders or ledges **43**. The spring finger **42** at the end of one segment **41** in one row of segments is connected to the spring finger **41** in the other row of segments and as a result a garter spring type of expansion ring is provided with a large open area **44** for oil drainage. As shown in FIG. 5 the segments **41** are bottomed on the inner peripheral wall **45** of the ring **11** with the legs **42** projected freely into the channel **23** but with the shoulders **43** spaced from the side walls **26** of the channel. As in the case of the assembly **10** the expansion ring of the assembly **10***a* has a substantially continuous circumferential contact with the oil ring at two points. Whereas in FIG. 1 the two point contact was obtained at the back or bottom wall **25** of the channel **23**, the two point contact in the assembly of FIG. 6 is obtained at the inner wall **45** of the ring at the inner end of the channel.

In the modification **10***b* of FIG. 7 the same oil ring **11** described in the embodiments **10** and **10***a* is provided but a different expander **50** is used which is more fully shown in FIG. 8. The expander **50** is a spring steel channel with top and bottom rows of circumferentially spaced segments **50** connected in staggered relation by vertical legs **51** around the inner periphery of the ring which are separated by relatively wide gaps or spaces **52**. As in the case of the expanders **12** and **40**, the expander **50** has the legs **51** connecting adjoining top and bottom segments **50** in staggered relation to form a garter spring. The segments **50** fit in the channel **23** of the oil ring **11** and have their peripheral edges **53** bottomed on the back end wall **25** of the channel **23**. The open gaps **52** between the legs **51** accommodate free drainage of oil back to the interior of the piston.

In the still further embodiment **10***c* of FIG. 9 the same oil ring **11** is provided but the expander **60** is corrugated as best shown in FIG. 10. This expander **60** is a ring of spring steel with radially corrugated U-shaped sections **61** alternately opening inwardly and outwardly and with the end legs **62** of the sections in abutted together relation to form a circumferentially expanding and contracting spring. The outer ends of the U-shaped sections **61** have upstanding legs **63** thereon of a height sized to slide freely on the legs **26** of the oil ring channel **23**. These upstanding ends **63** are bottomed on the back wall **25** of the channel **23**.

The inner periphery of the ring has upstanding tabs **64** on the U sections which fit freely in the piston ring groove.

As in the case of the embodiments **10** and **10***b* the expander **60** acts on the back end of the channel **26** and free drainage of oil scraped from the cylinder wall by the scraping edges **20** of the oil ring **11** is accommodated in the open spaces provided at the tops and the bottoms of the U-shaped segments **61** which, as shown in FIG. 9, are inwardly from the side legs **26** of the channel **23**. Further, holes **65** are provided through the legs **63** for registration with the holes or slots **22** in the oil ring.

The assembly **10***c* of FIG. 9 operates in the same manner as the assemblies **10** and **10***b* with the radial expansion load applied to the oil ring **11** at the back end of its channel by the legs **63**.

In FIG. 11 there is illustrated a modified oil ring **11***a*. This ring like the ring **11** has an inwardly opening circumferential channel **70** connected through slots **71** with a groove **72** around the entire periphery of the ring and positioned between scraping rims or beads **73**. The outer periphery of the ring however is coated with a hard facing material **74** of molybdenum, chromium, or the like.

The ring **11***a* has flat top and bottom faces **75** for slidable engagement with the sides of the piston groove and the channel **70** has flat radially extending side legs **76** and an axial end wall **77**. The outer periphery of the ring **11***a* has axial shoulders **78** extending inwardly from the end faces **75** in right angle relation thereto and terminating at radially outward and axially inward sloping bead walls **79** of the scraping edges. The scraping edges themselves are vertical or axial as illustrated at **80** and extend to the groove **72** which, as shown at **81**, has a rounded or dished base.

In FIGURE 12, a further modified oil ring **11***b* has parts thereof corresponding to identical parts in the oil ring **11***a* marked with the same reference numerals. In the ring of FIGURE 12 however the hard face coating is eliminated and the scraping edges **80** extend to conically tapered walls **81***a* forming the sides of the groove **72***a*. These walls converge to the slots **71** connecting the groove **72***a* with the channel **70**. The peripheral groove **72***a* therefore is generally U-shaped in cross section as contrasted with the groove **72** of the ring **11***a* which has a rounded base. The scraping edges **80** on the bead rims **73** are at the converged ends of the sloping walls **70** and **81***a* of the beads.

The oil rings **11**, **11***a* and **11***b* each include a rectangular channel in the inner diameter of the ring extending completely around the ring and opening inwardly. This permits various types of circumferential expanders to induce radially expanding force around the entire periphery of the oil ring. The expanding force can be induced at two land contact areas in the bottom of the channel or against the inner ends of the channel legs around the inner periphery of the oil ring. Further, the circumferential expanders can have single full land contact with either the bottom or the inner end of the channel. Uniform pressure around the entire periphery of the oil ring is therefore maintained and since the oil ring is rather shallow in radial depth and has great flexibility, it will quick adapt itself to any bore irregularities and will maintain good sealing contact with the cylinder wall.

The ring assemblies of this invention have excellent oil drainage. Since the expanding force is maintained around the entire periphery of the ring and is substantially continuous except for slight gaps between the expander ring segments, low unit loading pressure can be maintained without loss of sealing pressure. Reduced friction between the expander and the oil ring can be maintained by machine grinding the contacting surfaces of the expander and oil ring.

Although various minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent granted hereon all such embodiments as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. An oil control ring assembly for engine pistons having a degree of radial flexibility to quickly conform with an engine cylinder which comprises a one-piece outer split metal ring having a pair of flat radial faces and a single inwardly facing rectangular channel around the inner periphery thereof and between said radial faces, an outer facing groove around the outer periphery thereof, flat scraping edges at the sides of said groove and connecting slots through the ring joining the groove and channel in free flow communication, and a spring expander ring of U-shaped cross section with an outer opening channel bounded by legs slidably seated within the confines of the channel of the outer ring and having upstanding expansion fingers acting on said legs to exert a radial expansion force on the outer ring uniformly around the entire periphery thereof.

2. An oil control ring assembly for internal combustion engine pistons which comprises a one-piece split metal oil ring of shallow radial depth having a pair of flat spaced radial faces for slidably engaging the outer peripheral portion of the side walls of a piston ring groove, radially projecting axially spaced flat beads on the outer periphery of said oil ring defining scraping edges for engaging the bore of an engine cylinder, said oil ring having an outer peripheral groove completely therearound between said beads for receiving oil scraped from the engine cylinder by said scraping edges, said oil ring having a single inwardly opening rectangular channel around the inner periphery thereof and between said radial faces, elongated slots through said oil ring connecting the back wall of said channel with the bottom of said peripheral groove, and a spring steel expander ring of U-shaped cross section having the legs of the U situated within said channel and abutting the side walls and the back wall of the channel to exert two point expanding force around the periphery of said channel, said expander ring having upstanding spring fingers situated radially inward from said oil ring exerting radial expansion forces on said legs.

3. An oil control ring assembly which comprises a one piece metal split ring having flat ring groove engaging faces and having a pair of flat radial faces, a pair of axially spaced circumferential flat rims on said ring projecting outwardly from the periphery thereof, said ring having a continuous outwardly opening peripheral groove between said rims, said ring having an inwardly opening channel around the entire inner periphery thereof and between said radial faces, said ring having slots therethrough connecting the back wall of the channel with the bottom of the peripheral groove, and a steel expander ring of U-shaped cross-section having the legs of the U situated within the confines of said channel and bottom on said back wall of the channel and having upstanding expansion fingers acting on said legs to exert a radial expansion force on the outer ring uniformly around the entire periphery thereof.

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